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I. INTRODUCTION

Applied Research Laboratories, The University of Texas at Austin (ARL:UT), was awarded Contract N00140-76-C-6487, sponsored by the Naval Underwater Systems Center, New London Laboratory (NUSC/NL), effective 1 June 1976. Some of the work under this contract represents a follow-on effort to previous work sponsored by NUSC/NL under Contract N00140-74-C-6316.

The work under Contract N00140-76-C-6487 was originally divided into six task areas that focused on technical support in areas of sonar technology:

- I. AN/FQM-10(V) Sonar Test Set Field Support
- II. Transducer Repair Facility Test Site Field Support
- III. AN/WQM-5 Sonar Test Set Field Support
- IV. Special Purpose Passive Sonar Systems Support
- V. Sonar Instrumentation Test and Evaluation
- VI. Study of Towed Line Array Acoustical Testing at Transducer Repair Facilities

By Modification P00019, four additional tasks were added, as follows:

- VII. AN/SQM-() Sonar Noise Measuring Set Development
- VIII. AN/WQM-5 Series Sonar Test Set Development
- IX. Sonar Dome Maintenance Documentation Support
- X. AN/BQQ-5 Power Supply Development

This report is Quarterly Progress Report No. 7 under Contract N00140-76-C-6487, for the period 1 December 1977 - 28 February 1978.

II. TRF, AN/FQM-10(V), AND AN/WQM-5 FIELD SUPPORT

A. AN/FQM-10(V) Field Support

Upon request, ARL:UT provided NAVSHIPYD PTSMH TRF with instruction manuals for the Scientific Atlanta Positioner Control System, model 4161, and for two Simpson-Century milliammeters.

Units of the AN/FQM-10(V) repaired by ARL:UT include one SDVM model 1166, unit 74, and three Krohn-Hite amplifiers model DCA-50, unit 41.

ARL:UT furnished NAVSHIPYD MARE TRF with four diodes (Fairchild FJT1100) for the repair of their Scientific Atlanta differential pre-amplifier model 1116, unit 6.

B. AN/WQM-5 Field Support

ARL:UT furnished the following equipment to the specified facility.
NAVSHIPYD MARE TRF. (1) One each of printed circuit boards No. 1A4, No. 1A10, No. 1A23, and No. 1A35 for repair of unit 1, Ser A17.

(2) Two relays and four resistors for units 9 and 10, Ser A17, to repair the stored potential bleeder circuits.

NAVSECNORDIV. One AN/WQM-5, Ser A4, to be used while Ser A12 was being refurbished at ARL:UT.

NAVSHIPYD CHASN. One each of printed circuit boards No. 1A5 and No. 7A3.

COMPACAREA. One 4 to 8 kHz filter and one 8 to 16 kHz filter for unit 1.

NAVSEACENPAC. One printed circuit board No. 1A4 to repair unit 1 of AN/WQM-5, Ser A14.

NAVSHIPYD NORVA. One printed circuit board No. 7A3 to repair the audio amplifier unit of Ser A18.

MOTU 12 in Mayport, Florida. One each of printed circuit boards No. 5A3, No. 5A5, No. 5A7, No. 5A8 and one DDR power supply board to repair the AN/WQM-5, Ser B3.

III. SPECIAL PURPOSE PASSIVE SONAR SYSTEMS SUPPORT

The funds remaining in this task are sufficient only for completion of documentation. Work is continuing on Part II of a technical memorandum entitled "A Signal and Noise Analysis of Frequency Domain Equalizers" and a technical report entitled "Frequency Domain Equalizer Study."

IV. SONAR INSTRUMENTATION TEST AND EVALUATION

A. Introduction

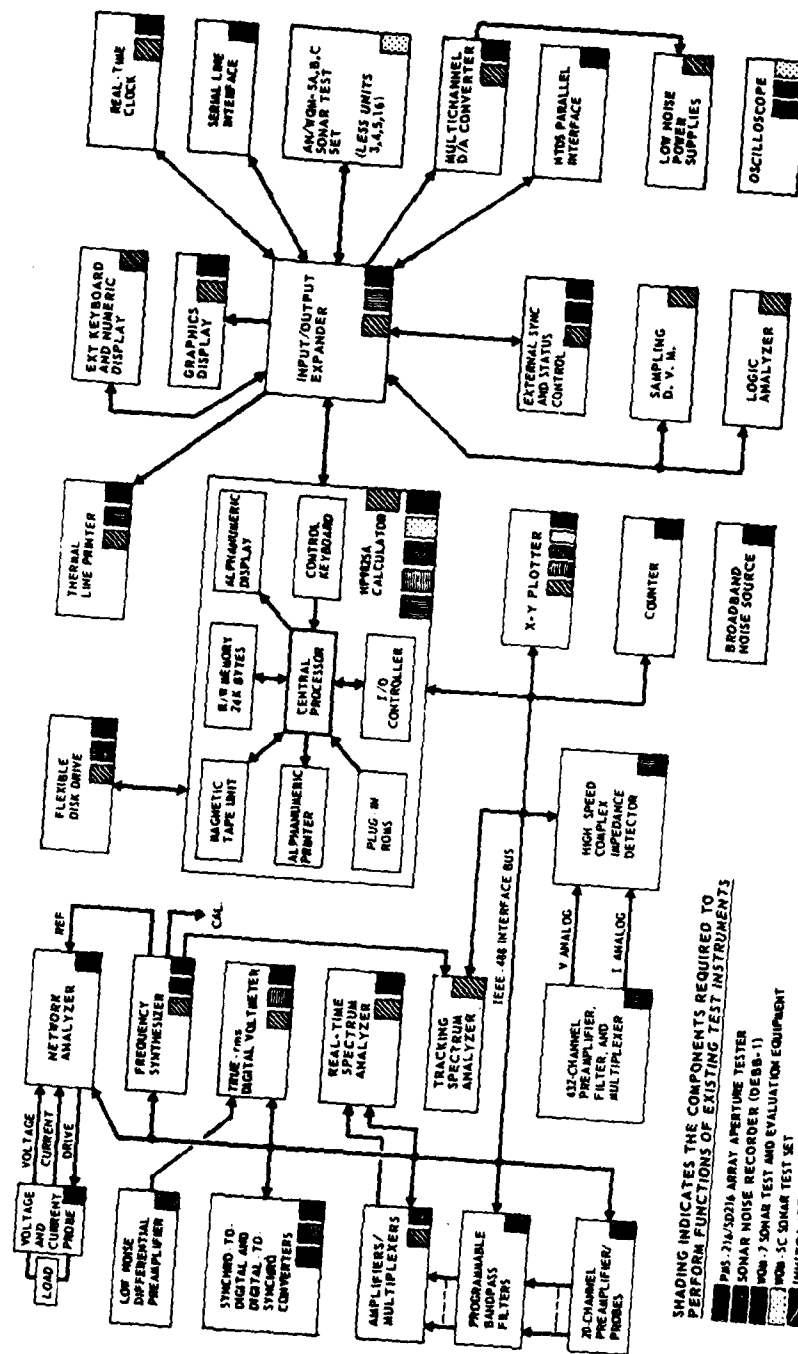
Previously reported work under this task focused only on the development of a replacement instrument for the AN/SQM-5 Sonar Noise Recorder. The development of this test set has been absorbed into the development of a larger test set that is now referred to as the AN/UQM-() previously called the AN/WQM-(). The "U" in the nomenclature indicates multiple areas of application (surface ship, submarine, shore based, etc.) whereas "W" means only surface or subsurface vessel applications. In addition, ARL:UT has worked on a task in support of the Sonar Alignment and Calibration Site (SACS), with particular emphasis on AN/SQS-35/38 system testing.

B. AN/UQM-() Sonar Test Set

The current conceptual block diagram of the AN/UQM-() is shown in Fig. 1. The first four kinds of applications depicted are for submarine and surface ship use; the last two are for TRF or laboratory use. The blocks identified for the sonar noise recorder application are marked, although the obsolescent AN/SQM-5 is not referenced on the figure. The DEBB-1, successor to the AN/SQM-5, is the French manufactured noise recorder currently in production.

It should be pointed out that most blocks in Fig. 1 carry no instrument model number at this time. Although most of the blocks are envisioned as off-the-shelf items, specific decisions have not yet been made.

During this report period two different brands of off-the-shelf true rms digital voltmeters were evaluated specifically for the sonar noise recorder application portion of the AN/UQM: the Hewlett-Packard



SHADING INDICATES THE COMPONENTS REQUIRED TO PERFORM FUNCTIONS OF EXISTING TEST INSTRUMENTS

- PMS-21U/50216 ARRAY TESTER
- SONAR NOISE RECORDER (DEBB-1)
- NON-7 SONAR TEST AND EVALUATION EQUIPMENT
- NON-5C SONAR TEST SET
- IMPEDANCE PLOTTER
- TOWED LINE ARRAY TESTER

FIGURE 1
AN/UQM-1 SONAR TEST SET

ARL - UT
AS-78-507
DDB - ORS
3 - 10 - 78

model 3437A system voltmeter and the Fluke model 8500A digital multiplexer. Both units satisfactorily performed the basic measurements as programmed by the system calculator/processor/controller (HP 9825A). However, both units were determined to be unacceptable.

The minimum time frame required by the Fluke 8500A to take a reading, convert it to the general purpose interface bus (GPIB), and then send it to the HP 9825A was on the order of 34 msec. This is unacceptable since the design goal for each completed measurement reading is 10 msec. In addition, many of the other portions of the Fluke unit would require extensive modifications which consequently would cancel its off-the-shelf attraction.

The HP model 3437A system voltmeter is essentially a programmable high speed digital-to-analog converter. This unit is unacceptable because extensive electronic modifications and additions would offset its off-the-shelf convenience.

Therefore, at this time, it is planned to assemble the low noise differential preamplifier, true rms converter, high speed analog-to-digital converter, and interface to the calculator from commercially available functional modular "building blocks." This approach will allow tailoring the electronics to the system needs while retaining most of the off-the-shelf availability through modules as opposed to entire instruments. Of course, this modular concept will also promote a smaller package size for the AN/SQM-5 subsystem.

Several digital-to-synchro and synchro-to-digital modules were also initially identified for integration into the subsystem. Plans for the next quarter are to obtain, breadboard, and evaluate various functional modules for the AN/UQM-(). As a result of these investigations, a specification for the noise recorder subsystem of the AN/UQM-() may be formulated.

C. SACS Support -- AN/SQS-26CX Sonar Controller

USS DOWNES (FF 1070) was tested at SACS during the period 29 November - 3 December 1977. The software needed to operate the sonar controller, being developed by Mr. J. Rea on site at SACS, was tested for the first time during the visit of USS DOWNES. As was to be expected with new software, many "bugs" were found and changes needed to be made; however, Mr. Rea was unable to work on these problems because of other commitments.

Modifications to the controller had been made (before USS DOWNES arrived) by the Naval Ocean Systems Center (NOSC), San Diego, California, in July 1977. Although those modifications were not expected to cause problems, errors were found during the visit to USS DOWNES that necessitated some further controller modifications at SACS. An additional problem was related to some optical isolator failures discovered for the first time during the USS DOWNES tests.

For these reasons, then, no controller tests were successfully completed during the visit of USS DOWNES.

The first successful software/controller tests were performed with a simulated ship on 11 December 1977. The system was checked for proper operation for both ship active (transmission tests) and ship passive (receiver tests). The 64-channel breadboard PFB multiplexer was also cycled and checked in preparation for USS RAY (DD 971), which has an AN/SQS-53 aboard.

USS RAY was tested at SACS during the period 12-15 December 1977. The ship remained three additional days after testing to allow the new SACS operators from the Naval Torpedo Station (NTS), Keyport, Washington, to test their first ship. This represented their first hands-on equipment experience.

Because of time limitations, ARL:UT and NOSC tests of the sonar controller were severely restricted. Only 7 h in two time blocks of 3.5 h were made available. During the first period, source level data of the ODT mode at three frequencies were acquired over $\pm 140^\circ$ coverage in 36 min. The second period was spent in setting up and acquiring data for CZ, BB/ODT, and BB/TRK modes, at three frequencies for each mode. Nine tests were merged into one run which, because of time constraints, was terminated before completion. However, stopwatch measurements allowed the prediction of a run time of 2 h 17 min for the nine tests. This compares to the normal test time of 3 h 40 min, excluding setup time in both cases. These tests must be considered successful in spite of the lack of data for presentation. The software and hardware performed as expected and much was learned about setup for merged tests. The software must be considered developmental in that changes and corrections, plus documentation, must be accomplished before the system can be considered operational. Furthermore, the NTS personnel presently operating SACS have a very difficult time learning and performing the straightforward SACS tests, much less being able to perform and monitor nine simultaneous tests.

USS O'BRIEN (DD 975) was tested at SACS during the first week in January 1978 by the new operations crew from NTS. More than the normal test time was expended because of the crew inexperience; thus no test time for the controller was available.

D. AN/SQS-35/38 Testing

No work was performed on this project because of other priorities.

V. ASSISTANCE WITH EXPANSION OF TRF CAPABILITIES
TO INCLUDE NEW TRANSDUCERS

Work on this project has been completed and all funds have been expended. ARL:UT is now working under Contract N00024-77-C-6035 on the task to specify and deliver to the TRFs the plant equipment items needed for work on sonar towed line arrays.

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VI. DOCUMENTATION SUPPORT

Early in December an edited copy of "Sonar Dome Handbook, Volume III, AN/SQS-38 GRP Sonar Domes" was received to form the basis of a new revision. Work was started immediately to produce a new manuscript from this material. It was evident that close liaison with individuals at Coast Guard Headquarters, who originated the new material, would be necessary for the success of the project.

By 28 February 1978 work on this document was well underway. No firm schedule for completion has been established because of the priority of other work.

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VII. AN/WQM-5 PROCUREMENT AND FIELD CHANGE PROGRAM

A. AN/WQM-5 Field Change Kits

C-Tech, Inc., delivered the first AN/WQM-5A kit to ARL:UT in October 1977 for testing. After the unit was thoroughly checked out, it was returned to C-Tech in November 1977 for minor rework on the interconnection wiring and small modifications to five printed circuit cards.

On 3 January 1978, this first AN/WQM-5A kit was received at ARL:UT. It was connected into an AN/WQM-5 system and performed very well. It was used shortly thereafter in support of two training courses conducted at ARL:UT, under another contract, to demonstrate the capabilities of the AN/WQM-5A.

The next item to be delivered to ARL:UT will be a complete AN/WQM-5A kit. The unit is expected to be shipped from the manufacturer's plant in early March 1978 and should be received at ARL:UT later in March for check-out. If this unit works well, C-Tech can begin to deliver AN/WQM-5A or AN/WQM-5B kits to ARL:UT at the rate of two to four units per month.

ARL:UT has procured and received all the off-the-shelf items from Hewlett-Packard (HP). In addition, the vendors for equipment cases have delivered the cases in which the HP items will be housed, with the exception of the carrying cases for the plotters. However, these units are on order and are scheduled to be delivered early in April 1978.

Work on the technical manual changes that are a part of the field change program has been accelerated. These technical manual items are not required under this contract, but are being pursued by ARL:UT under Contract N00024-77-C-6035. ARL:UT has recently retained the technical

assistance of Kentron International, Inc., to assist with the drafting of these technical manual changes.

B. Procurement of the AN/WQM-5A Sonar Test Set for Spain

Delivery of the AN/WQM-5A Sonar Test Set to the Spanish Navy has been delayed by a number of factors. The burn-in of the set could not begin until a production model of unit 3 was received. Thus, the burn-in began in January 1978 after the first production kit was delivered.

The set will be shipped as soon as the technical manuals are available and the required in-country spares are obtained. It is estimated that shipment will occur in May 1978.

VIII. AN/BQQ-5 SWITCHING POWER SUPPLY

ARL:UT has completed the study task of the design improvements to the AN/BQQ-5 Type 4B switching power supply. This work resulted in the development of an ARL:UT design of a modular power supply, which has been designed with 100,000 h MTBF as a goal. Redundancy has been used to ensure the reliability of this unit. Preliminary burn-in of several hundred hours has revealed no problems.

ARL:UT has been tasked under Contract N00024-77-C-6035 to build some additional test models of this supply and investigate applications of the design techniques to other AN/BQQ-5 supplies. This work is now in progress.

3 May 1978

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